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THE EFFECT OF BIOSOLIDS ON *MEDICAGO SATIVA* AND *FESTUCA ARUNDINACEEA* PLANTS PHYTOREMEDIATION PROCESS OF WASTE DUMP

EFECTUL BIOSOLIDELOR ASUPRA PLANTELOR DIN SPECIILE *MEDICAGO SATIVA* ŞI *FESTUCA ARUNDINACEEA* ÎN PROCESUL DE FITOREMEDIERE A HALDELOR DE STERIL

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The storage of waste dump gravely deteriorates the soil's physical, chemical and biological properties, both in the storage area and the surrounding zones. In time, serious perturbations may occur in the biocenosis from the surrounding ecosystems, through the sweeping away of the inorganic matter or through precipitations. The main problem in this case is to find the most suitable phytoremediation method for these waste dumps, by sowing plant species (grasses), in order to stop the erosion generated by wind and rain. Establishing a herbaceous "carpet" , in time, is very difficult, because the waste dump contains no organic matter, has a weak water retaining capacity and has a high bareness index. The purpose of this study was the experimentation of a method of cultivating the waste dumps using alfalfa, fescue and biosolids as fertilizers.

Key words: mining waste dump, biosolids, grass cover, phytoremediation

Introduction

Waste dumps represent inorganic material deposits, with sandy terrain appearance. On these terrains, the humus layer needed for plant growth develops very slowly, by atmospheric sedimentation and by nutrients bio-geo-chemical cycles initiated by the original vegetation [1, 2, 5]. An important aspect of fertilizing the upper layers of the waste dump is the introduction of organic matter, respectively a quantity of nutrients adequate for plant growth. On the other hand, in the urban areas, there is a great problem caused by depositing ever-growing quantities of wastewater sludge. The idea of using stabilized sludge (called biosolids) for the reclamation of waste dumps is not new. It has been used for over 30 years in some mining sites in Europe, U.S.A., etc. [2, 4, 5]

The benefits created by the biosolids in this respect are: fertilization of arid or semi-arid areas, improvement of some physical-chemical traits of these mine wastes (permeability, water retention, pH, nutrients proportions, temperature, ion exchange capacity, etc.), increasing the soil microbial activity, initiating and sustaining the cycles of nourishing elements (C, N, P), increasing the plant-covered surfaces, etc.

Waste dumps require large amounts of organic fertilizers, and the results of the current research shows that the biosolids quantity required is five time bigger than in the case of an agricultural land [3, 4].

In the current work, was experimented the technique of "grass covering" the waste dumps, using alfalfa and tall fescue, with biosolids fertilization.

Material and Methods

The study of the effect of biosolids on the growth and development of *Medicago sativa* and *Festuca arundinaceea* plant species has been made between march and September 2007 in the experimental field of the disciplines of Ecology and Biotechnologies for residual waste recycling from the Faculty of Animal Sciences and Biotechnologies, Timisoara.

The experimental block was made of eight lots, four for each plant under study. The surface of each experimental lot was 3 square meters. In the experimental block, the variants were as follows:

- M – control variant – plain soil of black-earth type;
- V1 – soil with mine tailings: 200t/ha incorporated;
- V2 – soil fertilized with biosolids – 40 t/ha;
- V3 – soil with mine tailings: 200t/ha incorporated, and fertilized with biosolids – 40 t/ha.

The plants growth and development was surveyed by measuring the quantity of phytomass (biomass) at the first mowing (first decade of June) and at the second mowing (last decade of September). At the second biomass harvesting, the remaining biomass and the roots weight were measured.

Results and Discussions

The results of analysis of the growth indexes for the two plant species are presented in Table 1.

From the presented data, it can be ascertain that in the case of *Medicago sativa* the biosolids exert a greater favorable effect on the plant growth, distinguished by a production benefit of 25.9% at the first mowing and of 13.8% at the second mowing. Taking into account the entire quantity of biomass (consisting of aerial phytomass, un-mowed rests and roots) the production benefit in the case of alfalfa is 5700 kg/ha, representing 18.4%.

Table 1 – The phytomass quantity resulted from the control mowings

Specification	Blank	Experimental variants		
		V1	V2	V3
Medicago sativa				
Phytomass quantity at the first mowing (kg m.v./ha)	14.300	16.300	18.000	19.300
Phytomass quantity at the second mowing (kg m.v./ha)	10.000	8.000	11.600	11.300
Quantity of un-mowed phytomass + roots weight (kg m.v./ha)	6.600	7.600	7.000	7.000
Total obtained phytomass (kg m.v./ha)	30.900	31.900	36.600	37.600
Festuca arundinaceea				
Phytomass quantity at the first mowing (kg m.v./ha)	17.600	15.300	17.300	21.600
Phytomass quantity at the second mowing (kg m.v./ha)	10.600	8.600	9.300	8.000
Quantity of un-mowed phytomass + roots weight (kg m.v./ha)	4.000	3.600	6.000	7.300
Total obtained phytomass (kg m.v./ha)	32.200	27.500	32.600	36.900

For the variant V1, with a tailings to soil proportion of 2.5 **:**1, the alfalfa yield is 13.9% bigger at the first harvest, decreasing with 20% at the second mowing. At the end, the production benefit is only 3.2%.

The greatest alfalfa yield is obtained at variant V3. Thus, in the case of leached black-earth type soil, with 200 t/ha mine tailings and 40 t/ha biosolids added, we obtained a substantial increase of green mass per hectare, distinguished by a 35% production benefit at the first harvest, 13% at the second harvest and 21.7% for the total phytomass index. The tailings to soil proportion was 2.5 to 1, and the precipitations regime for the summer of 2007 was normal for the western area of Banat's Plain.

As opposed to the *Medicago sativa*, the biosolids had a weak effect on *Festuca arundinaceea* plants at the first and second harvest, resulting in an overall production benefit of only 1.24%. In the case of V1 variant, with plants cultivated on soil with tailings incorporated, but unfertilized, the production of green mass is 13.1% lower at the first harvest, 18.9% lower at the second harvest, and 14.6 lower, overall.

From the presentation of the above data, it can be stated that the *Festuca arundinaceea* plants adapt with a greater difficulty on unfertilized soils with incorporated tailings.

Plants have a better growth and yield in the soil variant with incorporated tailings, but fertilized with biosolids, resulting in a production benefit of 22,7% at the first harvest. But, unlike alfalfa, which possesses a tap-root well adapted to summer's arid period, at the second harvest, the *Festuca arundinaceea* phytomass yield is lower, and the phytomass benefit decreases to 14.6%.

Comparing the results obtained by the two plant species, it is ascertained that, in the same ecological conditions, alfalfa accomplishes a higher production benefit than tall fescue with 46.8%.

Conclusions

1. In the case of soils with incorporated tailings, but unfertilized, the degree of coverage with grass and phytomass production are reduced. In such conditions, the *Medicago sativa* plants adapt more easily.
2. Biosolids fertilization insures an increased green mass production in the case of alfalfa, compared to tall fescue. The biggest green mass production is obtained from both species on soils with incorporated tailings and fertilized with biosolids. In the case of alfalfa, the production benefit was 48.6% bigger.

Bibliography

1. **Rate, W., Lee, K. M., Freuch, P. A.** (2004) - Application of biosolids in mineral sands mine reabilitation use of stockpiled topsolil decreases trace element uptake by plants, Bioresource Technology, 91, p 223 – 231
2. **Bengson, S. Y.** (2004) **-** Reclamation of copper tailings in Arizona utilising biosolids, The official publication of the American Society of Mining and Reclamation, vol. 1, nr. 2, p 3-6
3. **Silveiroa, M.L.A. Alloni, L. R. F., Guilherme, L.R.G.** (2003) - Biosolids and heavy metals in soils, Sciencia agricola, vol. 60, no. 4
4. **Robinson, B., Schulen, R., Novack, B., Roulier, S., Menon, M., Clothier, B., Green, S., Mills T.** (2006) - Phytoremediation for the management of metals flux in contaminated sites, For. Sonw. Landsc. Res. 80, 2, p. 221 – 234
5. **Mulligam, C.N., Yong, R. N.** (2004) - Natural attenuation of contaminated soils, Environment International, 30, p. 587 – 601.